PREFACE

Advances in foundation engineering have been rapid in recent years. Of note are the maturity of the concepts of soil–structure interaction, the development of computer codes to deal with advanced topics, the advent of new methods for the support of structures, and the proliferation of technical publications and conferences that present a variety of useful information on the design and performance of foundations. This book takes advantage of these advances by presenting methods of analysis while being careful to emphasize standard methods such as site visits and the role of engineering geology.

The goals of the engineer in the design of foundations are to achieve a system that will perform according to stipulated criteria, can be constructed by established methods, is capable of being inspected, and can be built at a reasonable cost. Acceptable performance usually requires limited vertical and horizontal movement in the short and long term. Chapter 6 presents several instances where foundations have collapsed or suffered excessive movement. The purpose of presenting such failures is to emphasize that knowledge of foundation behavior must be used and that care must be taken in predicting how soil will respond to the imposition of loads. However, other kinds of failure are also possible. On occasion, the use of advanced methods for the analysis of shallow and deep foundations is omitted due to lack of knowledge or time in completing a design. The result may be an unacceptable and unfavorable design requiring more costly foundations than necessary.

This book describes methods for computing the settlement of both shallow and deep foundations. The engineer may compute a substantial safety factor for a foundation and decide that settlement is not a problem. However, modern engineering is aimed at achieving compatibility between the foundation and

the superstructure, so computation of foundation settlement, even under relatively light loads, cannot be ignored.

USE OF THE BOOK IN TEACHING

The material in this book can be presented in several ways. The student is expected to have completed a basic four-semester-hour introductory course on geotechnical engineering. The book assumes that this course introduced the basic knowledge of soil behavior, one-dimensional consolidation, shear strength of soils under undrained and fully drained conditions, and laboratory testing of soils. If the course is a senior-level or a joint senior-level and introductory graduate-level course, the course should cover Chapters 1, 2, and 4 through 11 in their entirety. Portions of Chapter 3 can be presented as a review to the introductory course in geotechnical engineering. The material on the design of drilled shaft foundations should include a discussion of the basic methods of construction and should cover the methods of design for axial loading in cohesive and cohesionless soils. The design of drilled shafts in intermediate geomaterials or rock may be covered if time permits.

If this book is being used for a graduate-level course, the chapters on foundation design should be covered in their entirety, and design projects should include all foundation types in all applicable soil conditions. Chapters 2 and 3 may be omitted if students are required to complete another graduate-level course on advanced soil mechanics.

UNIQUE CONTRIBUTIONS OF THE BOOK

The movement of shallow foundations under an increasing series of loads can be computed in a relatively straightforward manner, but the same method cannot be applied to deep foundations. Detailed, comprehensive, and up-to-date methods are presented for determining the behavior of piles or drilled shafts under axial or lateral loading.

The following forms of the differential equation are presented for determining a deep foundation under axial loading:

$$E_p A_p \frac{d^2 w_z}{dz^2} = f_x C$$

and

$$f_z = \beta_z w_z$$

where $E_p A_p$ = axial stiffness of the pile, w_z = relative movement of the pile with reference to the soil at point z, C = circumference of the pile, f_z = unit

load transfer at point z, and β_z = is a function depending on the depth z and the value of w_z. The differential equation is solved using the difference-equation technique.

The differential equation for the deep foundation under lateral load is

$$E_p I_p \frac{d^4y}{dx^4} + E_{py} y = 0$$

where $E_p I_p$ = lateral stiffness of the pile, y = lateral deflection of the pile with respect to the soil, x = distance along the pile, and E_{py} = lateral stiffness of the soil corresponding to y. Again, the differential equation is solved by using difference-equation techniques.

The differential equations for axial loading and lateral loading are used to produce a solution for two-dimensional pile groups under inclined and eccentric loading. The treatment of a pile or drilled shaft as a deformable body whose deformations are dependent on all of the relevant parameters is on the cutting edge of the present technology. The combination of the behavior under axial loading and lateral loading to produce a method for determining the behavior of pile groups gives the engineer a complex but rational tool to use in the solution of a problem that was beyond the scope of practice until recently.

A student version of the computer codes for the pile under an axial load, for the pile under a lateral load, and for the pile group is included with the book. The programs allow demonstration of the solution of the homework problems in this book. The professional version of the computer codes is available to the industry.